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XIV. *An Account of the Earthquake which was felt at Manchester and other Places, on the 14th Day of September, 1777. In a Letter from Mr. Thomas Henry, F. R. S. to William Watson, M. D. F. R. S.*

S I R,

Manchester,
October 21, 1777.

Read Feb. 19,
1778.

THOUGH the shock of an earthquake which was felt on Sunday the 14th of September, in this and some of the neighbouring counties, was by no means equal to those terrible concussions which some foreign countries have at times experienced; yet as it appears to have been at least as violent as any that has happened in this island for many years, I thought a particular account of it might not be unacceptable to you, especially as some circumstances attending it seem to be connected with a branch of natural philosophy, for the elucidation of which mankind are much obliged to your industrious and ingenious researches.

On the morning of the day on which the earthquake happened, I was confined to my bed beyond my usual hour by a head-ach, with which I am generally troubled

previous to any storms or considerable changes in the atmosphere. About five minutes before eleven o'clock, I was alarmed by a noise which seemed as if it might have proceeded from a large bale of goods thrown down on a boarded floor below stairs: the house shook. I called out to my wife, who was in an adjoining closet, to know what could have fallen; when instantly I was astonished by such a rattling noise at the North-east corner of the house, that I cried out that a part of the house (which had been built within these few years, and was not so firmly connected with the old part as it should have been) was fallen; and in this opinion I was immediately confirmed by a third and more violent crash, resembling the tumbling down of a large and lofty wall. Each of these noises was succeeded by a separate concussion.

These events must have taken up the space of at least half a minute. During that time I got out of bed, and putting on my coat and waistcoat, ran to a window which commanded a view of one side of the suspected building, and to my great surprize found it standing. I then went to a window at the front of the house, where I also found every thing safe; and on being informed by several people, who had fled affrighted into the streets, that their houses and furniture had been violently shaken, I concluded

cluded the disturbance must have been occasioned by an earthquake.

I had now time to make inquiry how my wife had been affected; for my mind had been hitherto filled with anxious fears for the safety of my two youngest children, who were in that part of the house where I had apprehended the danger to be. The dimensions of the closet in which she stood were three yards by two. At the North-east corner, on the outside of the wall, is a leaden spout, which communicating with a wooden one conveying water from a lower building, discharges it, without coming into contact, into a leaden cistern, from whence a small pipe descends into the cellar. At a considerable height above these, another leaden spout proceeds obliquely from the Northern along the Eastern side of the house, collecting the water from the whole surface of the roof. From this quarter the noise, which was heard before the two last concussions, seemed to have proceeded.

My wife informed me, that at the instant of the second explosion she had received a very smart stroke on the top of her head, and, imagining that something had fallen off a shelf, looked down on the floor and perceived it heaving under her, but could see nothing that could have given the blow. Lifting up her eyes she saw her china and

every

every thing in the closet dancing on the shelves; and, during the third shock, the vibration of the walls was so great that she expected they would have fallen upon her. A pain, attended with a degree of stupor, remained in the part of her head which had been affected, for several hours after. Several other persons likewise received strokes similar to electrical strokes in different parts of their bodies.

In the churches, it being in the time of divine service, the greatest confusion and terror were occasioned. The congregations, suspecting that either the galleries or the roofs were falling in, endeavoured to escape with the utmost precipitation. Several people were thrown down and trampled on, and some few had their limbs broken. Nor is it to be wondered at that they were so terrified, as the pillars and walls evidently tottered, and the motion was so great as to toll the bells in the Collegiate and St. Mary's churches. My sons, who were at the latter, assured me on their return, that they heard the bell twice during the last shock, and the facts are besides well authenticated by variety of evidence.

The alarm was equally great in most of the places of worship in this town, except at St. Paul's church, which is a low building at the North-east side of the town, without a steeple, and has a common shore running under it.

How

How far these circumstances may have contributed to render the concussion less sensibly perceived there, I do not pretend to determine.

All the neighbouring towns were affected in a similar manner; but very considerable differences were observed in different parts of the same towns. At Blackley, a small village about three miles from this place, the shock was violent in the episcopal church, though very moderate in the dissenting chapel, situated not above three hundred yards from the other. The latter is a very low structure, stands at the foot of a hill, and has no leaden spouts to convey the water from the roof. At a house, about one hundred yards beyond this, placed on an eminence, a servant, stooping at some little distance from a chest of drawers which stood up to the wall, received so severe a blow from it as to strike her to the ground.

The water in many places was agitated. The passengers in the duke of Bridgewater's boat, who were on the canal, did not perceive any change; but the steersman recollects, that the vessel was suddenly stopped at that time, which he could not then account for.

The noise was particularly loud in those houses which were furnished with conductors; and, as far as I have been able to collect, it was loudest in those parts of the houses where the conductors were fixed.

Many

Many people complained, for several days after, of nervous pains and hyfteric affections, and of sensations fimilar to thofe of perfons who have been ftrongly electrified. Perhaps the fright might have contributed to have produced fome of thefe effects. For my own part, my head-ach, which feldom leaves me before evening, was intirely and immediately removed. A report prevailed, and it was pofitively afferted, that a boy at Rochdale, who had been long deaf, had recovered his hearing at the infant of the earthquake; but, upon the moft ftrict inquiry, the fact does not appear to be fufficiently authenticated.

Different people in the fame rooms were affected in various degrees, and felt the fhock more or lefs violently. Neither the vibration nor noife were perceived by moft perfons who were travelling on the roads or walking in the ftreets. Yet others, on looking at the houfes, perceived a great undulatory motion in them. Thofe who flood on mofs or loofe garden ground felt it heave under them very perceptibly; and others, who fat or lay upon the ground, were fo fhocked as to be thrown forcibly out of the pofition they were in.

To myfelf and feveral others, who obferved the progrefs of this phenomenon coolly, three fhocks were very
clearly

clearly distinguishable. Some persons were sensible of two, and some of one only.

The motion of the earthquake, at least of a rushing wind which attended it, was from South-west to North-east. It was felt at York, Lancaster, Liverpool, Chester, Birmingham, Derby, and Gainsborough; and within this circuit, the diameter of which must be 130 or 140 miles, with greatest violence in this neighbourhood, which appears to have been the center of it.

In Derbyshire, through a great part of which county I have since travelled, the shock was strong on the Western, and weak on the Eastern side of the Peak. I cannot find that any of the mines were injured by it, though it had been reported that some of the foughs had fallen in. Nor does it appear, that in the great extent of country, which was thus violently agitated, any more material damage was suffered than the throwing down some chimnies. Praised be that kind, super-intending Providence, who rides on the whirlwind, and directs the storm; and who graciously put a period to this awful and tremendous scene, when we were apparently on the brink of destruction!

To you, SIR, who have so intimate a knowledge of electrical subjects, it would be impertinent to make any observations on the above facts. Perhaps many of them

may tend to confirm Dr. STUKELEY'S theory of earthquakes being occasioned by the accumulation and discharge of the electrical fluid: yet I cannot but observe, that the state of the atmosphere and of the season seems to have differed in many points from that which he describes as preceding the earthquakes in the years 1749 and 1750.

Dr. STUKELEY says, that for four or five months the weather had been warm to an extraordinary degree, the wind generally South and South-west without rain. That in the marshy parts of Lincolnshire the drought had been so great on the surface of the earth, that the inhabitants had been obliged to drive their cattle many miles to water. That before the London earthquakes, vegetation was as forward in February as it usually is in April. That the *aurora borealis* was frequent, unusual in its colours, and even removed to the South; and that the whole year had been remarkable for fire-balls, lightning, and coruscations.

In the present year the spring and summer had been in general remarkably cold and unseasonable, the wind varying from North-west by West to South-east by South, the latter of which commonly brought rain. During the latter end of the month of May, and part of June, the weather was exceedingly dry, and very sharp frosts destroyed

destroyed most of the early fruit; particularly one in the middle of June was so severe as to kill whole fields of potatoes; an instance scarcely ever known at that season. In July the ground was refreshed for a fortnight with frequent and plentiful showers, succeeded by about an equal period of dry and warm weather. Throughout most of the month of August the rains were violent and the air cold. Vegetation was backward, and all kinds of fruit crude and insipid. On the fifth of September the weather became warm and serene, and continued so with an Easterly wind, except on the ninth, when some showers fell, till the day of the earthquake, and for some days after. Vegetation now became more quick. An electrical machine worked with uncommon vigour the day before the earthquake; but was observed to act as weakly two days earlier. During the summer I do not recollect above two thunder-storms; nor was the *aurora borealis* by any means frequent. A fire-ball was observed about two months before; and a water-spout fell on the 23d of July, near Huddersfield, in the West-riding of Yorkshire, which did considerable damage to the country^(a).

The

(a) It is Father BECCARIA's opinion, that in a thunder-storm the clouds serve as conductors to convey the electric fluid from those places of the earth

The morning on which the earthquake happened was clear and serene. The air was so far from being sultry, that some persons who rode out early in the morning complained of the coldness of it. The wind was Easterly. At the instant of the shock it is said to have veered to the West, and to have immediately returned to its former station. My barometer had risen in the night. When I observed it, about fifteen minutes after the earthquake, it stood at thirty inches, and it continued to rise all the day. One gentleman, who had marked the height of the quicksilver in his barometer that morning, observed that it had fallen a few lines at the shock, but it soon rose again to the same place. The thermometer at noon stood at 63°.

No cloud, except a few scattered white ones, such as our atmosphere is seldom free from, was observable either before or after the conclusion, and no rain was discharged either on that or several following days.

which are overloaded with it to those which are exhausted of it. In the summer of the present year, while the Southern counties were deluged with rain, this part of the kingdom was thirsting for want of it. And afterwards, while long continued heavy rains impeded the ripening of the corn, and threatened destruction to the harvest in this country, I am informed, that the counties in the neighbourhood of London enjoyed a clear sky and fine weather. I am ignorant what was the state of the atmosphere in the South in the month of September.

On

On the 20th, 21st, and 22d of September much rain fell, attended with thunder and lightning. The storm was particularly violent on the 21st in the neighbourhood of Rochdale, twelve miles from hence; and early on the morning of the 22d the whole hemisphere appeared, from this place, to be involved in one general blaze.

Should this account appear to you sufficiently interesting to be communicated to the Royal Society, I shall be obliged to you if you will introduce it when they meet. I have given a plain but authentic narrative of facts, and have avoided drawing any inferences from them, conscious of my own inability to investigate so obscure and intricate a subject.

